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Web Portal for Elderly Patients to Research Prescription Medication

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La Salle University Capstone

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1.1 Introduction

The population of the citizens over the age of 65 in the U.S. continues to grow annually. In 2011 people 65 and older numbered 41.4 million which constituted 13.3% of the U.S. population (www.aoa.gov). This segment of the population includes people who were born after 1945 and they are commonly referred to as 'baby boomers'. In addition to the natural aging process this group also encounters physical and mental-health related issues, which requires them to take prescription and over-the-counter (OTC) medication. Depending on the issues they may take a number of different drugs. For instance, a person may have a prescription drug for the treatment of high blood pressure from their doctor but can also have drugs prescribed from another doctor for a heart problem. In addition they may be taking an OTC drug for the treatment of a cold. Taking multiple drugs can lead to adverse reactions, unexpected results and even death. Patients cannot always determine the reaction that comes with taking a mixture of different drugs. The history of medical errors due to misread or misunderstood prescription labels define the problems seniors face with taking multiple medications. Sack (2013), a medical doctor states the following when seniors mix statins and niacin:

"The combination of popular prescription cholesterol drugs (statins) and OTC niacin (a type of B vitamin that lowers cholesterol) can increase the risk of muscle damage and cause severe muscle pain. Statins also pose a risk to patients when taken with prescription oral fungal/ yeast infection medications because of

the impact it can have on the kidneys." The project proposal is the development of a database and website to help seniors obtain and reference information on the affects of drug reactions when mixed with other drugs as well as possible side effects.

Medication Errors

Medication errors among adults over the age of 65 are rapidly growing and are one of the most common health problems in the U.S. A medication error is defined as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer."(U.S. FDA *Medication Errors,* 2013, para.1) Roughly 38% of the medication errors for people 60 and over are caused by human error. (Szczepura, Wild, Nelson 2011) Misread and misunderstood labels, illegible handwriting of doctors, prescriptions having similar names, interactions with other medicines, allergies, incorrect dosage (under or over) being dispensed, and labeling and packaging errors are the most common mistakes.

Reasons for Medication Errors

Medication abuse affects 17% of older adults. (TIP 2013) It is hard for physicians to diagnose medication abuse because the symptoms mirror other medical issues commonly seen in older generations. The Institute for Safe Medication Practices (ISMP) and the U.S. Pharmacopeia (USP) found that similar drug names (drugs sounding the same but are used for different ailments) account for 25% of all medication errors. (Curran 2009) Some examples include Inderal and Adderall,

Zyrtec, and Zantac. Doctors' handwriting has attributed to 27.8% of medication errors. (Daw Systems Inc. 2011) Since 2010 there has been a huge push to have all prescriptions sent electronically to the pharmacies, however even this is not foolproof. There is still a 12% error rate of all electronically submitted prescriptions. (Small, Pharm, Barrett, Price 2008)

According to the FDA, an increase in risk with prescription errors occurs with people 60 and older because they take multiple prescription medications. Before 2010 the severity of the situation was grossly underestimated and rarely brought to the public's attention.

This demographic group uses a vast amount of prescription drugs to treat and control health related issues. Logue (2002) a registered nurse with the University of Virginia Health Services Systems points out in a 2002 study in the Journal of the American Medical Association (JAMA) that many adult Americans use large quantities of medications regularly. The JAMA study also found:

> "Most of them take at least one prescription or non-prescription drug or a vitamin, mineral supplement weekly. And those rates were higher according to age: 94% of women 65 or older take at least one medication, 57% take five or more, and 12% take 10 or more. Among men 65 or older the numbers vary slightly – 12% were found to use 10 or more medications, 44% five or more medications and 91% used at least one medication" (2002, p.339).

Taking a mixture of prescription drugs can lead to uncertain results and uncommon side effects. The elderly need a central, user-friendly resource to find this information.

Creation of an information source that contains the names of prescription drugs, formulary status and drug interactions of these products would not only help elderly patients but can aid family members that serve as caregivers in helping to prevent medication errors.

2.1 Polypharmacy

Many of the issues faced by the elderly can be attributed to physiological changes and multiple comorbidities. In medicine comorbidities are defined as medical conditions existing simultaneously with and usually independently of another medical condition (http://www.merriam-webster.com/dictionary/comorbid). Polypharmacy refers to the use of more medications than are clinically indicated (Riker & Setter, 2012). Taylor (2011) from West Suffolk Hospital further defines polypharmacy as taking four or more different drugs that have the potential to interact with each other. Combining a number of medications increases the chance of interactions. In addition particular consideration needs to be given also to OTC medicines as they can cause possible health risks when mixed with other medicines. Factors associated with polypharmacy include (Wilcox 2006):

- An accumulation of chronic diseases with age – polypharmacy is common in older people because they tend to have more illnesses for which medications are prescribed;
- The introduction of new drugs for previously untreatable diseases – the introduction of a new drug to the patient's regimen may have adverse side effects and adds to polypharmacy by increasing the number of drugs the patient has to administrator;

- Proof of the efficacy of treatment in older people, such as hypertension, use of statins – treating symptoms rather than defining a diagnosis can result in failure to recognize an adverse drug reaction (ADR) and continue polypharmacy;
- Failure to review and discontinuing medication – the elderly and their doctors may not review the current drug dosage on a timely basis to ensure the dosage needs to be adjusted or in some cases discontinued;
- Failure to consider non-pharmacological treatment – rather than prescribe medicine for a particular sickness or illness doctors can seek alternative treatment measures such as dietary and herbal supplements to decrease polypharmacy

2.2 Adverse Drug Reaction

As more medications are introduced into the daily routines there is the potential for ADR. A 1990 Los Angeles Times article (Libman) points to a 1989 report by United States Inspector General that stated 'mismedication of seniors is a critical health issue'. The inspector general's report said a predominant reason that elderly folks are more likely than other groups to be mismedicated is that they suffer more chronic illnesses and use more medications. Libman further reports that in 1987 at least 200,000 elderly Americans were hospitalized due to adverse drug reactions or experienced drug reactions while in the hospital.

Taylor (2011) makes the point that the body changes over time and the body itself plays a major role in how medicine is processed. For instance the liver reduces in size with age and its ability to metabolize drugs may decline. This can lead to drugs not being absorbed effectively, which increases the risk of toxicity in the elderly.

Sack (2012), a Medical Doctor, who is board certified in addiction medicine and addiction psychiatry also indicates adverse drug interactions are one of the leading causes of death in the U.S. Doctors prescribe medicines very often without weighing the risks and benefits. And certain medicines when taken together can decrease or block another drug's effects and cause one or both drugs not to work as intended.

2.3 Medication Errors

With the loss of cognitive stability such as weakening eye sight in the elderly it is difficult to read labels on their prescription medicine. This can lead to mistakes in properly taking of prescribed dosage of medicine (Logue 2002). Arthritis and tremors can disable older adults and prevent them from opening their medicine bottles (mainly the child-proof ones). If hand and eye coordination are affected pills may be lost or dropped leading to mismedication errors. Logue indicates loss of memory is one of the most common causes of improper medicine use by elderly folks who forget to take their medicine, or they forget that they already have taken a pill (resulting in double dosing), or changing their medication schedule.

Technological Solutions

Technology might be a resource for helping to eliminate some of the errors that are attributed to improper medication dosages. Today technology is being applied in the health care industry to help assist the elderly in a number of ways. Logue (2002) suggests the following items to help the elderly adhere to their medicine regiment:

- The Cadex Medication Reminder Watch is a twelve (12)-alarm watch with reminder text message and it also includes a beeping sounder. A sample text message prompt

can contain the name and strength of medication. It has large numbers for readability and the volumes for beeper alarms can be adjusted higher or lower.

- Med Prompt's Medical Paging System is a pager message screen which alerts users to take medication. It provides dosing and other instructions.
- Talking Prescription (e-pill) is a small device that attaches to the bottom of the pill container. It features a recorder for a 60 second message of information for the patient. This item is great for patients who have problems reading the fine print on prescription bottles. One device is required for each prescription bottle but the patient must remember when it is time to take their medications.

3.1 Database

The purpose of this project is to create a technology-based information source to assist people, especially older adults who take a mixture of prescription and OTC medications. Research shows many people are unaware of the affects of drug mixture and side effects. This information source will serve as a point-of-reference to inform all users of possible issues and side effects of known drug-to-drug reactions.

A website and database will provide information about medication to assist with choices. The project will develop the database and prototype for the proposed solution. The website will contain listings of known medications and their reactions. It will serve as a repository to allow cross-reference of different medications and the reactions when they are mixed. The goal of the site will be to allow easy access to the information. The design of the website will include user interface characteristics

which will help serve not only the elderly patients but also their doctors and caregivers.

3.2 Web Portal

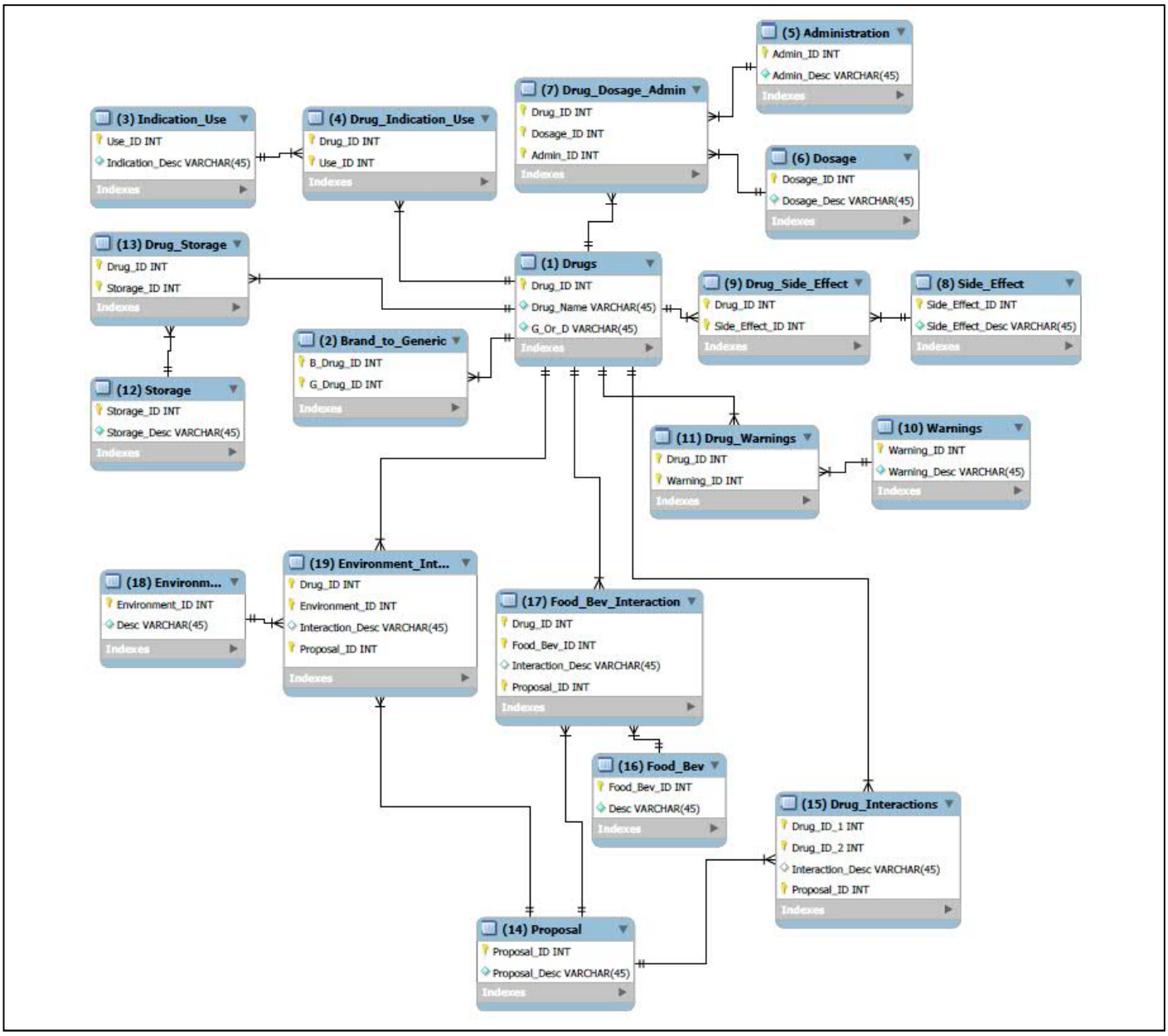
Access to the database will be through a website portal screen. User access to the site's medication information will not require credentials. The information available on the site is for user knowledge. User knowledge and information are one of the goals for this site so security is not an issue. Another goal is easy access to medication information.

Database Requirements

The Drug Details database will retain all information pertaining to generic and brand drugs. An online web application will utilize the Brand-name information stored in the database and display it in a neat and organized way for the user. The users will be able to select a drug name and based on that selection data pertaining to that drug will be displayed; including drug use, administration, warnings, storage information and more. The system is targeting users 60 years of age and older so the database access screen will employ clear and colorful graphics and slightly larger font types to make visibility easy on the eyes. The database will contain the most recent drug information as well as have a recovery point for application and system outages. The database design also allows for real time updates in case the manufacturer issues a product recall or a drug is discontinued.

4.1 Entity Relationship Diagram

The entity relationship (ER) diagram for the database is below:



4.2 Database Description

The online web portal obtains its data from a database. This database contains 19 tables: Drugs, Brand_to_Generic, Indication_Use, Drug_Indication_Use, Administration, Dosage, Drug_Dosage_Admin, Side_Effect, Drug_Side_Effect, Warnings, Drug_Warnings, Storage, Drug_Storage, Drug_Interaction, Food_Bev, Food_Bev_Interaction, Environment, Environment_Interaction, and Proposal.

The Drugs table is interconnected to all the other tables; using the Drug_ID ensures that all the drug information is captured and depicted correctly in the portal. Appendix B describes how each table is distinctly connected to one another. The Drugs table houses all prescription and over the counter drugs names and then assigns each drug an ID to make them unique. The Brand_to_Generic table houses any Brand drug that has a generic drug available as an alternative. The Indication_Use table houses what the drugs can be used for e.g. high blood pressure, headaches etc. The Drug_Indication_Use table connects the Drug to what it is used for e.g. Aspirin is used for headaches.

The Administration table houses how to take the drugs e.g. orally – twice a day. The Dosage table houses the amount of the drug to take e.g. 200mg, 1 tsp. etc. The Drug_Dosage_Admin table tells you how to take or administer the drug at each dosage level. The Side_Effect table houses information on what may happen if the drug is taken e.g. drowsiness. The Drug_Side_Effect table connects each drug to their specific side effects e.g. Benadryl can cause drowsiness. The Warnings table houses information on what you shouldn't do with the drug e.g. DO NOT take double dose. The Drug_Warnings table connects each drug to their specific warnings e.g. you should not take Fluticasone if you've had recent nasal surgery.

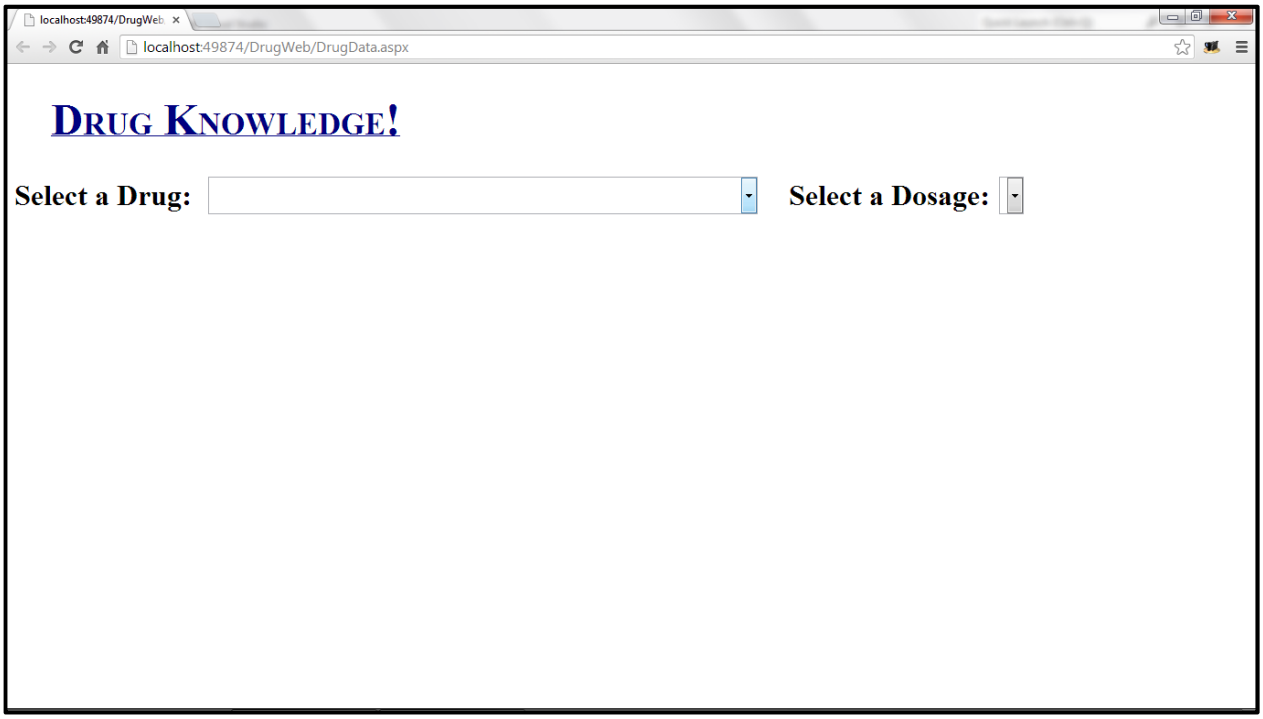
The Storage table houses how to keep the drugs e.g. keep at room temperature. The Drug_Storage table connects each drug to their specific storage information e.g. Canasa should be stored between 20 and 25 Celsius degrees. The Drug_Interaction table houses information on which drugs interact with each other and what the interaction may entail e.g. Fluticasone and Ritonavir taken together can significantly increase plasma. The Food_Bev table houses any food or beverage that may interact with the drugs. The Food_Bev_Interaction table connects each drug to any food or beverage it may interact with.

The Environment table houses any environmental factors that may interact with the drugs. The Environment_Interaction table connects each drug to any environmental factors it may interact with. The Proposal table houses what steps to take if a serious interaction or side effect takes place e.g. consult a physician without delay.

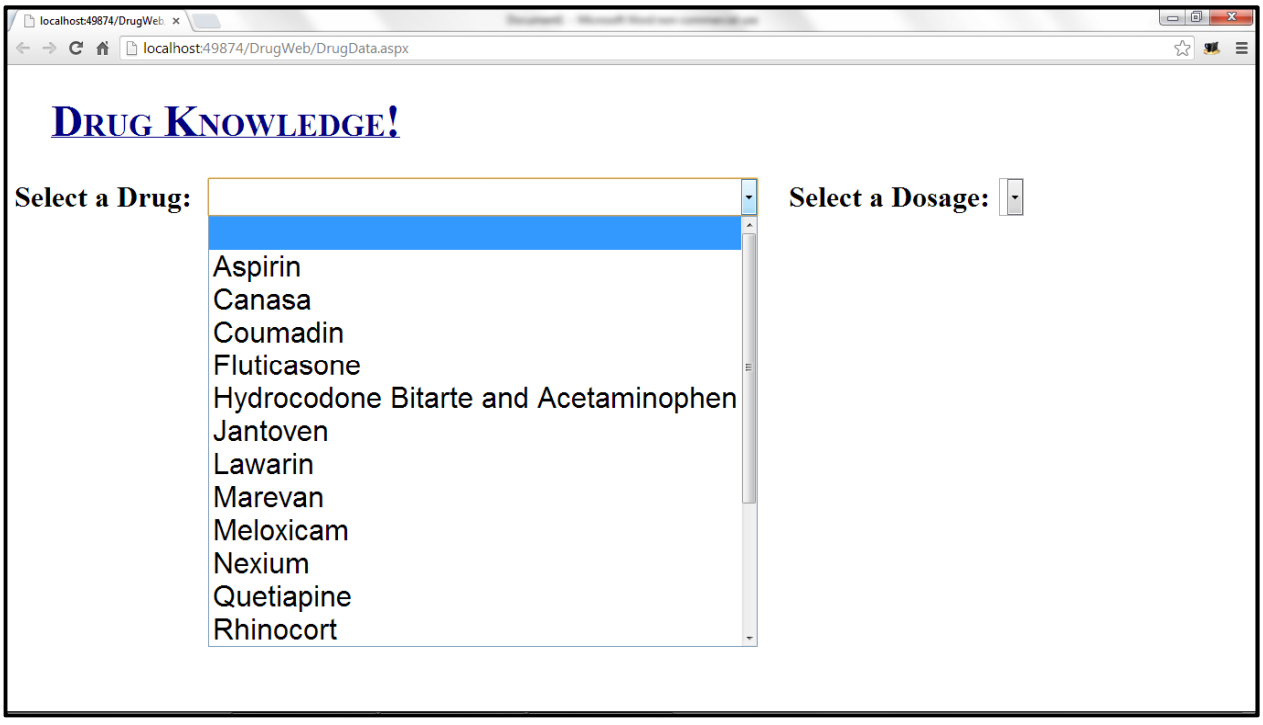
4.3 User Access and Guide

The following pages outline the typical usage of the web portal for medication information.

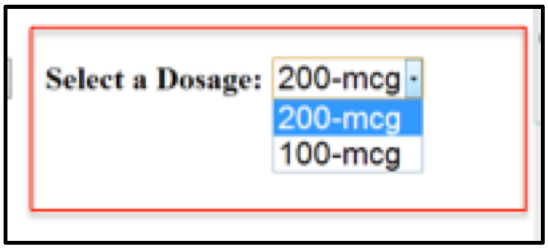
The system is clean and simple for elderly patients to utilize as well as any other user who would want to find important medication information quickly.



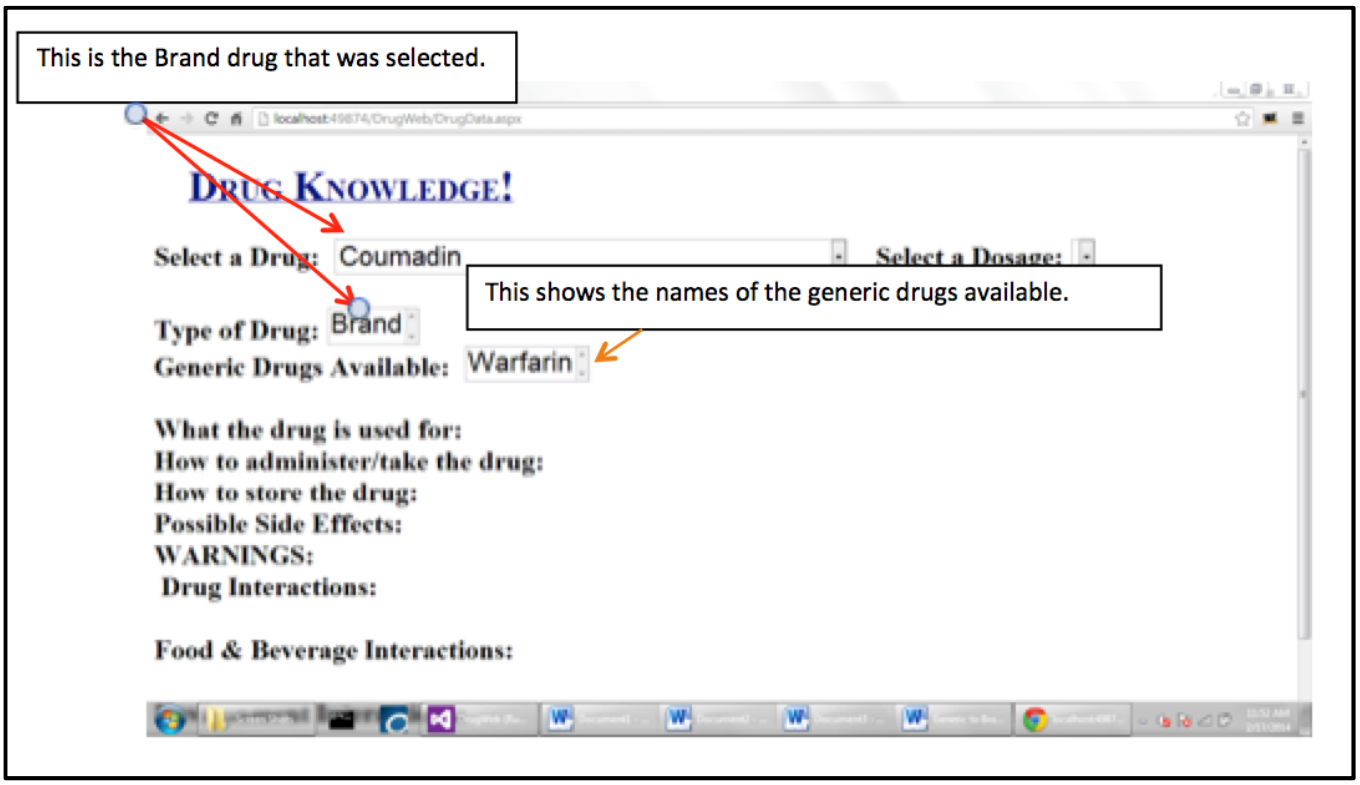
The system allows the user to select a drug that he/she needs information about:



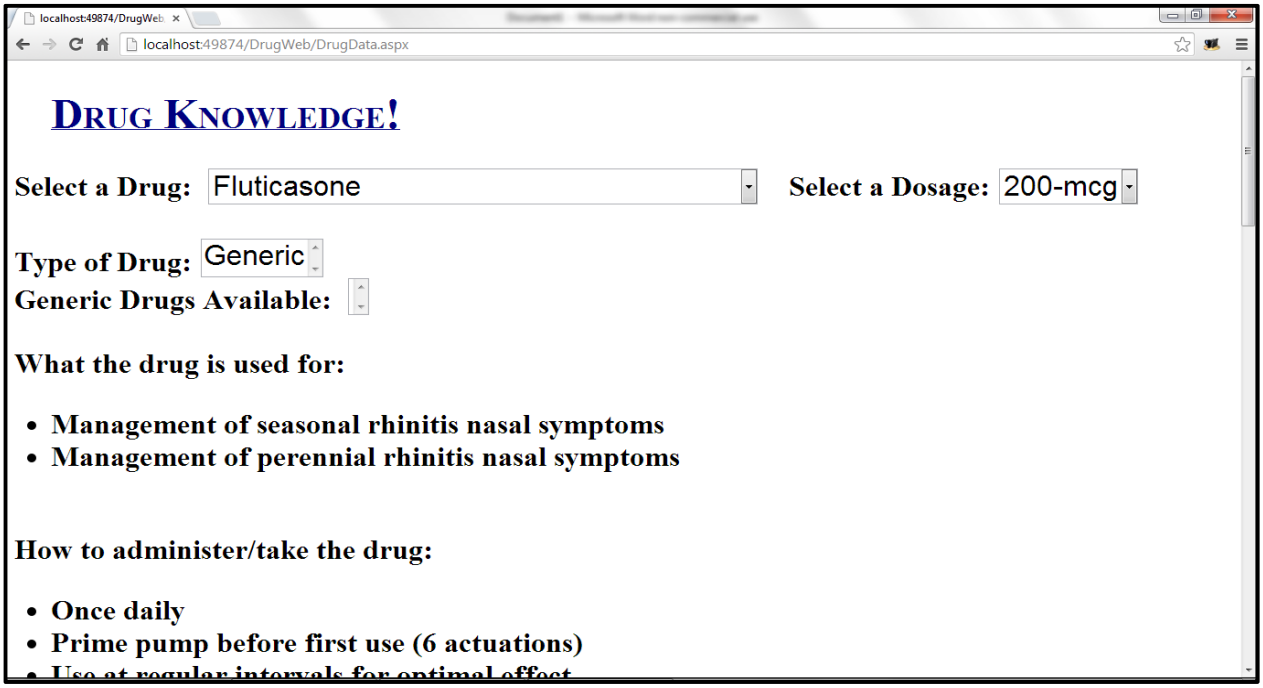
The system dosage defaults to the typical amount the user would be prescribed, but can be adjusted accordingly from the dropdown choices.



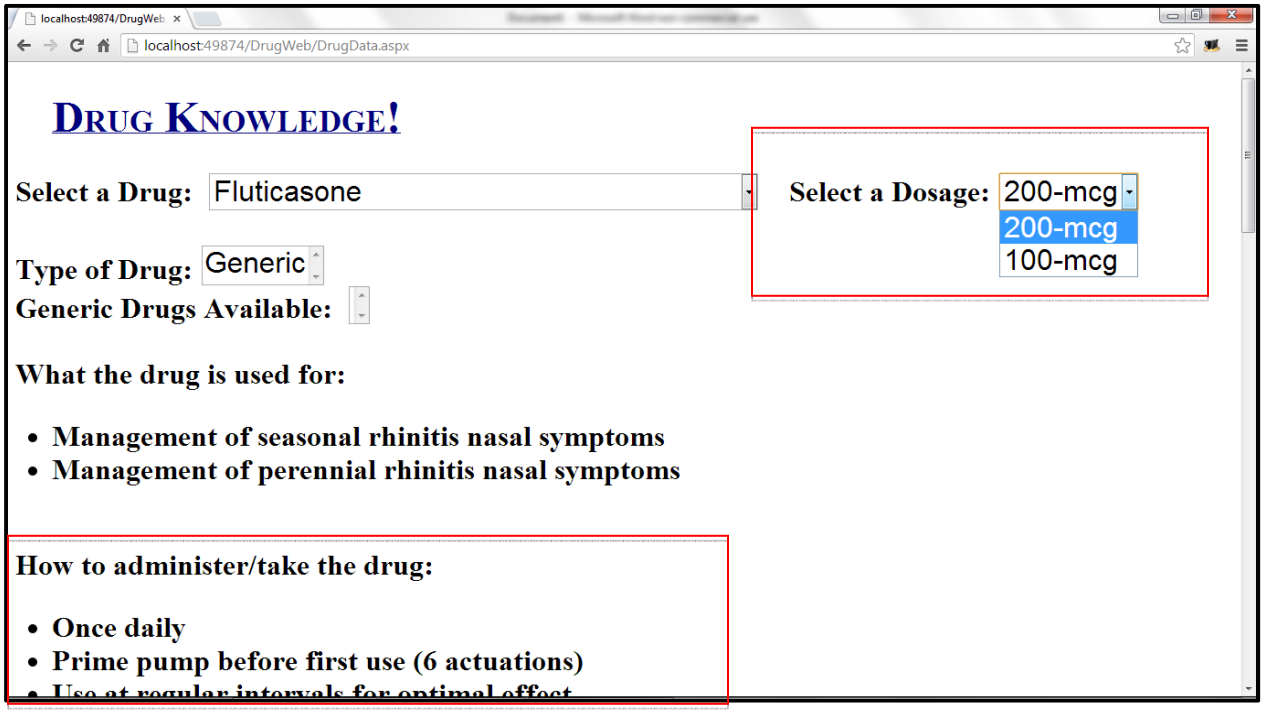
If a 'Brand' medication is selected and a generic version is available, it will be shown as in the screenshot below. Notice that the generic drug will be shown clearly so the user will know the name and be able to ask his/her pharmacist about generic options at the pharmacy.



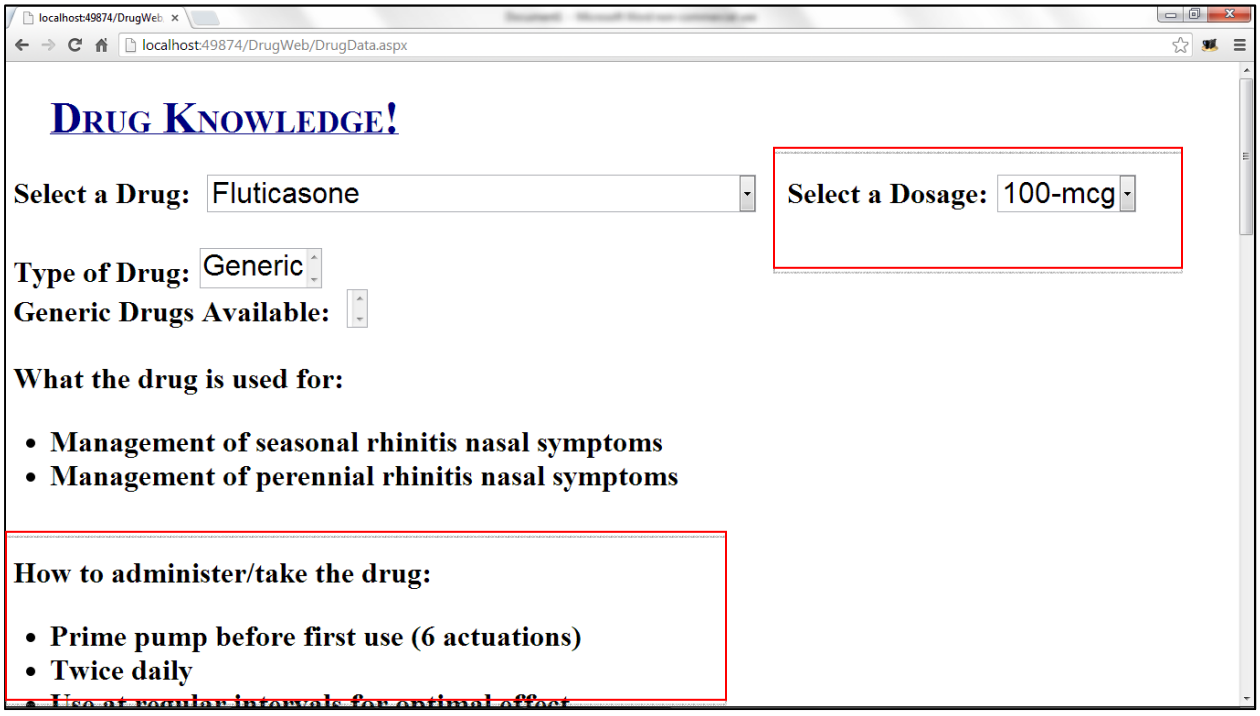
After the medication is selected along with the appropriate dosage, the information about the drug is displayed. The medication is identified and if it is a brand name will show if a generic is available. Details about the drug are clear and concise, not overly complicated for the user.



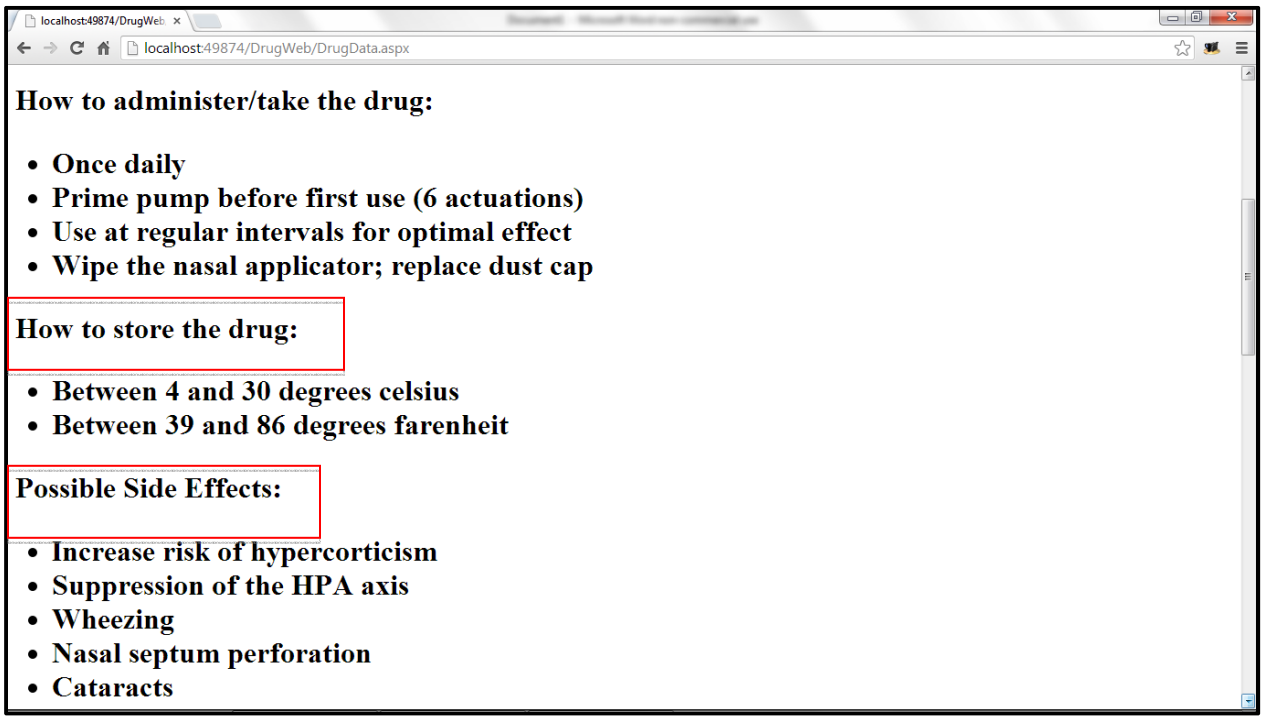
After selecting Fluticasone, the user can see the difference in administration of the medication by selecting the dosages available.



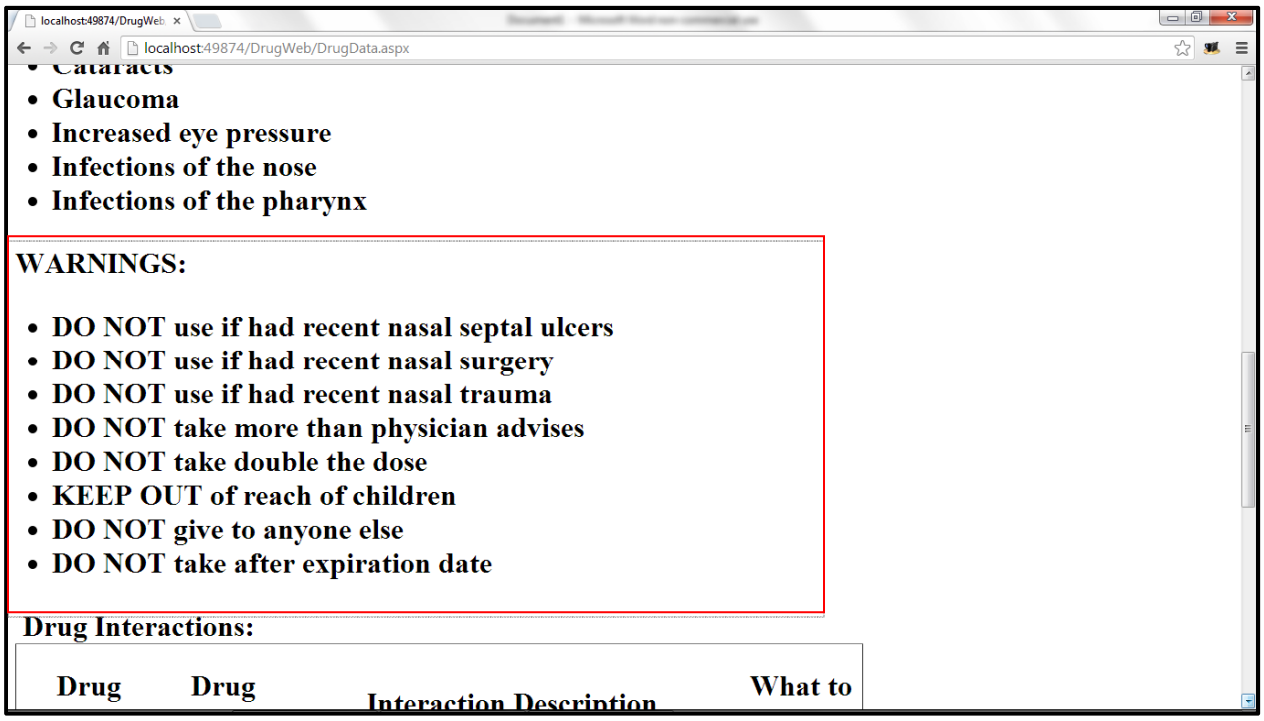
Here the user can easily see that the 100-mcg dose needs to be taken twice daily whereas the 200-mcg dose needs to be taken only once daily.



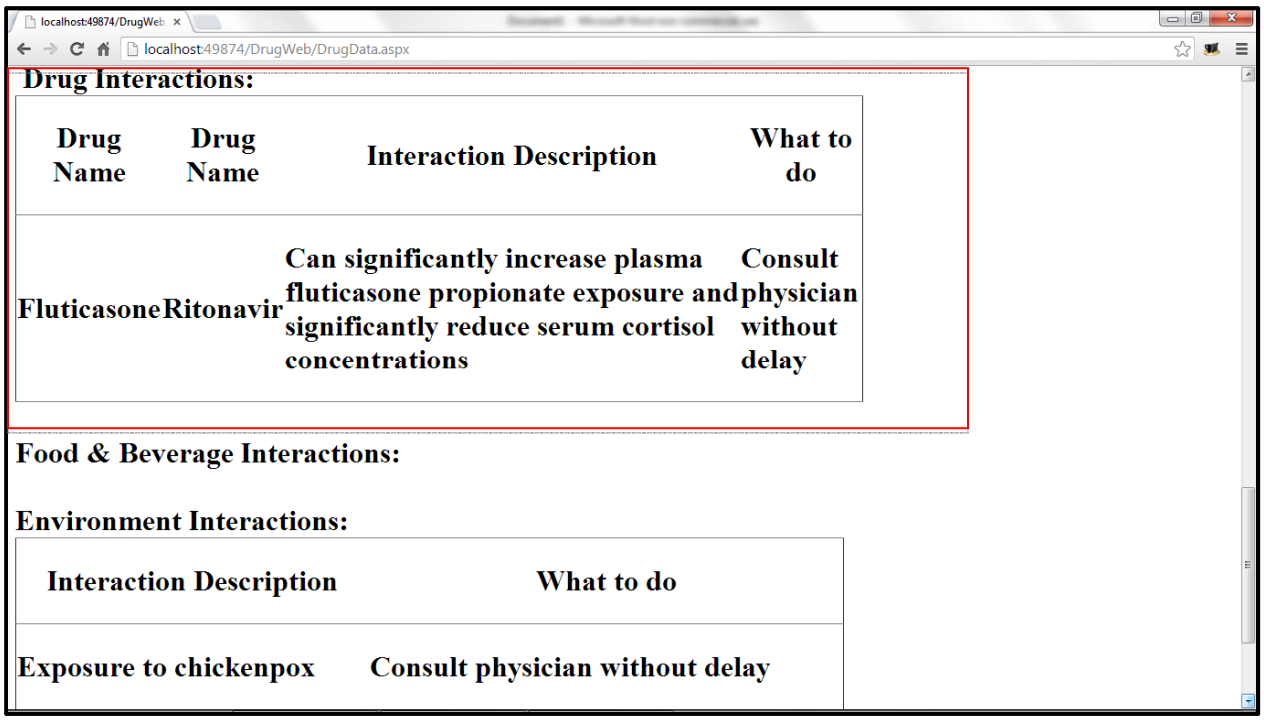
The system allows the user to see all relevant information about the medication on a simple page layout. After the administration section, the user can see how to store the medication, then possible side effects.



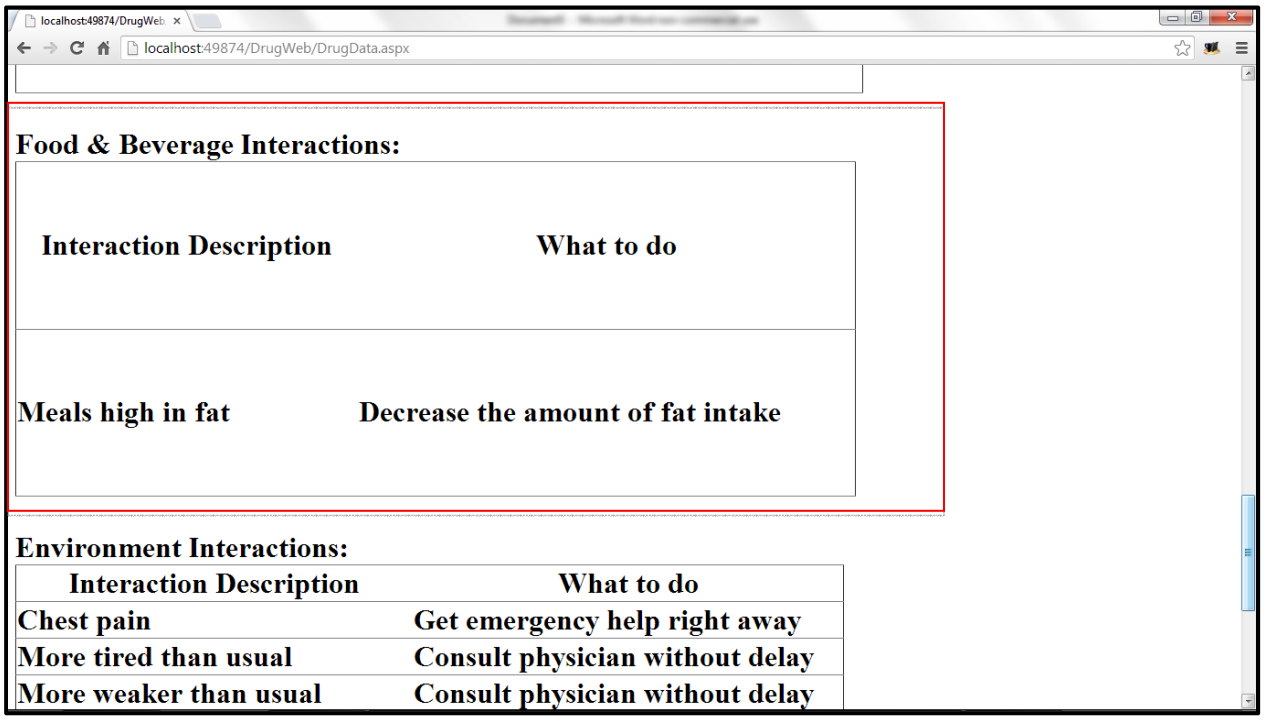
The 'WARNINGS' section highlights all the possible warnings when it comes to the medication.



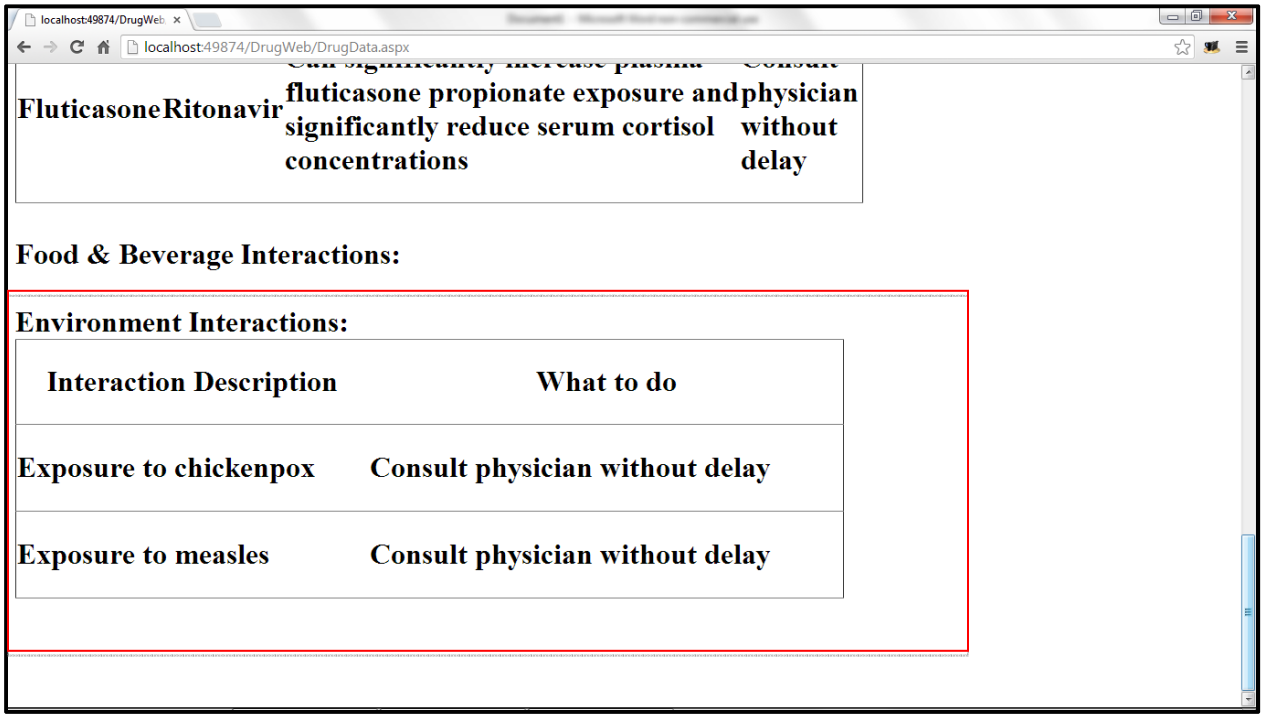
The system allows the user to view the 'Drug interactions' that the medication may cause issues with other drugs being taken.



The system allows the user to view the 'Food & Beverage interactions' specific to the medication chosen above.



Finally, the system allows the user to view any 'Environment Interactions' that may be associated with the medication chosen above. The screenshot below shows an example of data that may be viewed by the user.



5.1 Future Updates

To add features that would allow for exporting medication information to .pdf files for printing and saving of medication information. Implement the ability to update database in real-time with up to date medication information from various web sources.

Clean up the user interface from prototype to production. This would include aesthetic changes such as color and graphics. Graphics would include pictures of medication brands. We would also look to update the company information of those who produce the products in order for users to research companies for drug discount programs, coupons, etc.

5.2 Lessons Learned

We learned many valuable lessons during this project. The first was the amount of planning and collaboration involved in the project. Without a clear and concise plan of action in place before the project we found that our timeline tended to extend without realizing it. Just as in the 'real world', many I.T. projects fail due to the complexity unforeseen or projected. We learned that it is critical to plan effectively and efficiently in order to have success with an I.T. project. Scope creep is a real concern with I.T. projects and we saw instances of this with our project. A valuable lesson to learn in an educational atmosphere which will help prepare us for any real world obstacles we may face in the future.

The second lesson for our team is delegation is key to success. In order to be successful leaders in a project like this and in our respective areas of work, delegation is key to success. We were able to identify each other's strengths early on, but it took until towards the end of our project where we all needed to take accountability for each task assigned. Overall, the biggest takeaway has been how to work as a team effectively and efficiently can be difficult at times, but we were able to make strides with the task at hand once this realization came to the forefront.

Appendix A – Database Design Documentation

See Attached Document

Appendix B – Source Code

See Attached Document

Appendix C - Additional Items

Description of prototype clicking on each drug in the list:

Aspirin – Only populates what type of drug it is; does not produce any other information at this time – is used as an interaction for another drug

Canasa – what type of drug it is, what it is used for, how it is administered, how to store it, possible side effects, and warnings

Coumadin – what type of drug it is, what generic drugs are available

Fluticasone – what type of drug it is, what its used for, how it is administered, how to store it, possible side effects, warnings, Drug interactions, and environment interactions

Hydrocodone Bitarte and Acetaminophen - what type of drug it is, what its used for, how it is administered, how to store it, possible side effects, warnings, and environment interactions

Jantoven– what type of drug it is, what generic drugs are available

Lawarin – what type of drug it is, what generic drugs are available

Marevan – what type of drug it is, what generic drugs are available

Meloxicam – what type of drug it is, what its used for, how it is administered, how to store it, possible side effects, warnings, drug interactions, food and beverage interactions, and environment interactions

Nexium – what type of drug it is, what its used for, how it is administered, how to store it, and possible side effects

Quetiapine – what type of drug it is, what its used for, how it is administered, how to store it, possible side effects, warnings, food and beverage interactions, and environment interactions

Rhinocort - what type of drug it is, what its used for, how it is administered, how to store it, possible side effects, and warnings

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